

Attachment 1
Focused Feasibility Study Work Plan
Evaluation of Management Alternatives for Potentially Impacted Water and Sediments
Leviathan Creek Beaver Dam/Pond Complex
Leviathan Mine Site
Alpine County, California

1 INTRODUCTION

This Focused Feasibility Study (FFS) Work Plan evaluates potential remedial alternatives to address impounded surface water and stream sediment/floodplain soil in the lower section of the on-property reach of Leviathan Creek. A significant portion of this stream reach is occupied by a beaver dam and pond complex (BD/PC). The goal of the FFS is to evaluate various management alternatives for the BD/PC as they relate to risks (if any) posed by water quality degradation, sudden hydraulic releases and sediment scour/transport/deposition. The alternatives will be evaluated in the framework of primary balancing criteria: short-term effectiveness, long-term effectiveness and permanence, reduction of toxicity, mobility and volume of contaminants, implementability, cost and consistency with the final remedy to be developed and implemented at a later date.

Samples of surface water, precipitate, and various generations of stream sediment/floodplain soil in the area of the BD/PC have been collected and analyzed as part of ongoing remedial investigation (RI) activities. In addition, ongoing RI efforts are evaluating the surface water/groundwater interactions throughout this area. Preliminary evaluation of the data collected to date indicates changes in surface water quality are occurring within the area of the BD/PC. Surface water quality parameters have been generally found to improve immediately downstream of the BD/PC in Leviathan Creek relative to upstream conditions. There are currently multiple working hypothesis for the observed changes in water quality and additional investigation work is underway to further understand the mechanisms affecting these changes.

Preliminary data evaluation indicates that some floodplain soils associated with the BD/PC have elevated concentrations of some metals of concern. The interaction between the floodplain soil/surface water quality is also currently under investigation. Based on preliminary reviews of the data, it is possible that remedial actions may be required to address floodplain soils, sediments, and ponded surface water within the area of the BD/PC as part of the selected site-wide remedial action to be implemented following issuance of the ROD. The process for selecting the preferred remedial alternative(s) for the BD/PC will include review and analysis of previous work completed in this area, identifying criteria to be used in developing and selecting alternatives, developing and performing treatability testing of alternatives, detailed analysis of alternatives based on the treatability testing, and reporting on the alternatives including selection of the preferred alternative.

Among other tasks, this FFS will include treatability testing (anticipated for summer 2017) of certain measures aimed at partially reducing the volume and areal extent of impounded water within the BD/PC. If the selected remedial action includes sediment/floodplain stabilization, excavation, or other intrusive response actions in this part of the site, some amount of water management is likely to be required to facilitate that work. However, observations made during performance of Remedial Investigations in this area suggest that the BD/PC currently provides effective stabilization against scouring and transport of potentially impacted historical sediments and floodplain soils during large runoff events that may occur before completion of the FS and the remedy selection process. Therefore, any

removal or structural modifications to the dams performed as part of treatability testing will need to carefully consider the potential consequences for sediment mobilization and downstream conditions and structures.

1.0 INTRODUCTION

- 1.1. Stakeholders
- 1.2. Regulatory Drivers
 - 1.2.1. UAO
 - 1.2.2. RI/FS Process
- 1.3. Site Location and Existing Conditions
 - 1.3.1. Figure showing location of beaver dam/pond complex
 - 1.3.2. Figure showing details of beaver dam/pond complex
 - 1.3.3. Site Topography, including Leviathan Creek Basin Landslide and site access roads
 - 1.3.4. Hydrology, including stream hydrographs
 - 1.3.5. Recent and historic floodplain soil/sediment deposition
 - 1.3.6. Geology and Hydrogeology of Beaver Pond/Dam Complex, include representation of typical beaver pond cross-section
- 1.1. Objectives
 - 1.1.1. Identify and assess alternatives for:
 - 1.1.1.1. Managing impounded/flowing water
 - 1.1.1.2. Mitigating impacted stream sediment/floodplain soil in area of flowing and impounded water and incorporating alternative into final remedy
 - 1.1.1.3. Managing sediments recently deposited in series of beaver ponds and incorporating alternative into final remedy
 - 1.1.2. Evaluate protection of human health and the environment
 - 1.1.3. Evaluate compliance with ARARs
 - 1.1.4. Evaluate long and short term effectiveness
 - 1.1.5. Evaluate implementability
 - 1.1.6. Evaluate costs
 - 1.1.7. Identify primary technical and administrative challenges
 - 1.1.8. Identify fatal flaws or other concerns related to modifications to the beaver dam/pond complex

2.0 BACKGROUND

- 2.1. Previous Activities and Studies
 - 2.1.1. RI surface water characterization (March 2016 surface water TDSR)
 - 2.1.2. Monitoring of field water quality parameters in BD/PC (On-Property FRI Work Plan Amendment 9)
 - 2.1.3. Investigation in Leviathan Creek floodplain to characterize nature and extent of potentially mine-related materials deposited in floodplain (Amend 10 work plan, April 2016 preliminary results report)
 - 2.1.4. Phase I and Phase II Investigations of dam mud, pond mud material evaluation
 - 2.1.5. Surface water / groundwater interaction investigation (In-progress Amend 11 work plan)
 - 2.1.6. RI Groundwater TDSR (March 2016)
- 2.2. Source, Nature, and Extent of Beaver Dam/Pond Complex
 - 2.2.1. Dams
 - 2.2.1.1. Number and Size of Dams
 - 2.2.1.2. Debris Volume
 - 2.2.1.3. Stability

- 2.2.1.4. Chemical characteristics of dam mud
- 2.2.2. Surface Water
 - 2.2.2.1. RI SW Monitoring results
 - 2.2.2.2. Note that when the ponds are full and streamflow is greatest, pH is moderate. pH is acidic during low-flow, and largest pond is partially full to dry
- 2.2.3. Ponded Water
 - 2.2.3.1. Water chemistry
 - 2.2.3.1.1. Ponds
 - 2.2.3.1.2. Acidic Pond
 - 2.2.3.1.3. Spatial trends – upstream, within, downstream
 - 2.2.3.2. Sources, rates and volume
- 2.2.4. Pond Bottom Sediments (precipitate, stream sediments and floodplain soils)
 - 2.2.4.1. Chemical Characteristics
 - 2.2.4.2. Depth and Volume
 - 2.2.4.3. Stability and Mobility
 - 2.2.4.4. Geochemical interactions with surface water

3.0 INITIAL DEVELOPMENT AND SCREENING OF BD/PC MANAGEMENT ALTERNATIVES

- 3.1. Evaluation based on Guidance for Conducting Treatability Studies under CERCLA (EPA 540 R-92 071a, October 1992)
- 3.2. Evaluation against threshold criteria
 - 3.2.1. Overall protection of human health and the environment
 - 3.2.2. Compliance with ARARs

4.0 DESKTOP EVALUATION OF ALTERNATIVES

- 4.1. Modeling
 - 4.1.1. Development of Preliminary Vertical Profile of Leviathan Creek
 - 4.1.2. Volume of Impounded Water in Each Pond
 - 4.1.3. Water balance (surface and subsurface contributions)
 - 4.1.4. Flood flow patterns
 - 4.1.5. Sediment transport
 - 4.1.6. Energy Dissipation with and without BD/PC
- 4.2. Options for Reducing Impounded Water
 - 4.2.1. Breach and/or complete removal of select beaver dams
 - 4.2.2. Pumping and Diversion of Water
 - 4.2.3. Stream re-routing
 - 4.2.4. Lowering and/or Removal of Water behind Dams
- 4.3. Options for Stabilizing Floodplain Soils/Sediment
 - 4.3.1. Armoring
 - 4.3.2. Stabilization/Solidification
- 4.4. Options for Energy Dissipation Evaluation
 - 4.4.1. Prefab Dissipation Control Structures
 - 4.4.2. Rip Rap Structures
 - 4.4.3. Lined Channel – Geogrid or other material
- 4.5. Options for Downstream Sediment Control
 - 4.5.1. Long-Term
 - 4.5.2. Short-Term

5.0 SELECTION OF COMPONENTS FOR FIELD DEMONSTRATION TESTING

- 5.1. Select Components based on Desktop Evaluation for Field Demonstration Testing
- 5.2. Test Plan for Selected Components
 - 5.2.1. Procedures and Field Implementation/Data Collection Sequencing

6.0 IMPLEMENTATION OF FIELD DEMONSTRATION AND MONITORING

- 6.1. Detailed dam complex survey and inspection
- 6.2. Install Sediment Control Measures
- 6.3. Breach Selected Beaver Dams (Achieve partial reduction in impounded water)
- 6.4. Sediment Armoring
- 6.5. Channel Modifications
- 6.6. Quantitative and Qualitative Monitoring
 - 6.6.1. Streamflow and Storage in Beaver Ponds
 - 6.6.2. Surface Water Chemistry in Leviathan Creek and Beaver Ponds
 - 6.6.3. Dam Stability
 - 6.6.4. Sediment Stability
 - 6.6.5. Total Suspended Solids in Downstream/Ponded Water
 - 6.6.6. Vegetative Growth (macronutrients, micronutrients, alkalinity and agronomics, plant cover)
 - 6.6.7. Other Parameters as Needed

7.0 REPORTING

It is anticipated that the following sections may be included in the FFS report, though this is a preliminary list of sections and may be modified. This section will not be included in the work plan.

- 7.1. Introduction
- 7.2. Components Evaluated
- 7.3. Field Procedures
- 7.4. Results of Demonstration Testing
- 7.5. Evaluation of Management Alternatives
 - 7.5.1. Evaluation based on Guidance for Conducting Treatability Studies under CERCLA (EPA 540 R-92 071a, October 1992)
 - 7.5.2. Balancing Criteria
 - 7.5.2.1. Long term effectiveness and permanence
 - 7.5.2.2. Reduction of toxicity, mobility and volume
 - 7.5.2.3. Short term effectiveness
 - 7.5.2.4. Implementability
 - 7.5.2.4.1. Permitting and Other Administrative Requirements
 - 7.5.2.4.2. Technical Feasibility
 - 7.5.2.4.3. Sequencing/Scheduling
 - 7.5.2.5. Cost
 - 7.5.2.5.1. Capital Expenditures
 - 7.5.2.5.2. Operational Expenditures
 - 7.5.3. Consistency with Final Remedy
- 7.6. Identification of Potential Beaver Dam/Pond Complex Management Alternatives
 - 7.6.1. Each of the following alternatives would need to be considered in context of reducing hydraulic risk as well as erosion and downstream transport of floodplain soils/sediments and iron-based precipitate.
 - 7.6.2. No Action
 - 7.6.3. Alternative No. 1
 - 7.6.4. Alternative No. 2

- 7.6.5. Alternative No. 3 (if necessary)
- 7.7. Preferred Beaver Dam/Pond Complex Management Alternative

8.0 SCHEDULE

- 8.1. Gantt Chart
 - 8.1.1. Draft Work Plan submittal 1st Quarter 2017
 - 8.1.2. Initiate 2017 Field Demonstration Program 2nd Quarter 2017
 - 8.1.3. Partial Dam Breach(es) and Partial Reduction in Stored Water Volume 3rd Quarter 2017
 - 8.1.4. Draft Interim Report 1st Quarter 2018
 - 8.1.5. Data Acquisition Through 3rd Quarter 2018
 - 8.1.6. Draft Final Report 3rd Quarter 2018

9.0 REFERENCES